sky are indispensable to every active astronomical observatory and to every astronomer who wishes to study the fainter stars. Unfortunately, the original edition of this work is exhausted, so that copies can no longer be supplied. A new edition is being prepared by the Bonn Observatory, and will be published shortly, provided that subscriptions for a hundred copies, at seventy Marks each, are promised before May 1, 1898. The price is very low, considering the amount of material furnished. After that date the price will be raised to one hundred and twenty Marks. The Astronomical Conference held at the dedication of the Yerkes Observatory appointed the undersigned a committee to aid this project. Orders for copies may be sent to the publishers, Messrs. A. Marcus and E. Weber, Bonn, Germany, or will be transmitted to them by any member of the committee. It is proposed to publish a list of American subscribers, and it is hoped that at least fifty copies will be taken by American astronomers. Since charts deteriorate rapidly by constant use several copies should be taken by each of the larger observatories. The members of the committee have shown their appreciation of the value of this work by ordering twelve copies for use in the institutions under their direction. It is of the greatest importance that the subscription list should be filled, as it is probable that in the future many similar enterprises may be undertaken, whose success will depend upon that now attained.

EDWARD C. PICKERING,
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SCIENTIFIC LITERATURE.

Theoretical and Practical Graphics. By FREDERICK N. WILLSON, C.E., A.M., Professor in the School of Science, Princeton University. (Author's Edition.) 1897. 4to. Pp. viii + 264 + Appendix.

This is a most attractive work, not only conquering elementary graphics entire, but containing much more of highest geometric interest, including a fairly complete course on higher plane curves.

The part of the subject where Church so long held supremacy in America, with his Descriptive Geometry, justly appreciated for its elegance, is paralleled by Professor Willson in his chapter I. and chapters IX.–XII., 117 pages in all, including 219 figures in the text, where he not only covers with equal conciseness and elegance the matter of Church's 138 pages of text and 21 pages of illustration (102 figures), but in addition has treated many new and important matters, such as the Conoid of Plücker (articles 333, 356, 477), a favorite surface of Sir Robert Ball, applied in his Theory of Screws, which itself may be looked upon as in part an application of non-Euclidean geometry, also the Cylindroid of Frézier (§§ 333, 360, 489), the corne de vache (§361, 475–6), and some special helicoids (§ 480–4), and also has covered the Third Angle (or 'shop') method of employing descriptive geometry, and given a very full treatment of development (§§ 405–20). The mathematical surfaces are beautifully illustrated.

The general plan of the book, while providing a comprehensive graphical training in the form of a progressive course, admits of specialization, of shorter courses, with noticeable flexibility. In fact, eight sub-groupings are indicated for independent courses. Comparison with the special treatises scrupulously cited shows the extent of matter on all topics usually treated to be surprisingly great. Professor Willson has a gift for condensing without loss of clearness.

With this power, he does well to restate for convenient reference many of the fundamental definitions which he presumes already in some form previously mastered—for example, the definition of the trigonometric functions on p. 31.

But I still prefer the definition in the note on p. 121, "A straight line is the line which is completely determined by two points:" to the author's second thought given in the preface, "The line that is completely determined by any two of its points." The spheric space of non-Euclidean geometry, though movable as a whole in itself, is such that two geodetic lines in it always cut in two points.

Of course, no spherical trigonometry is employed in the author's solution of the problems of trihedrals, purely a graphic process, as it should be. We are glad to find as an appendix

the author's brief but weighty paper on Trochoids which was presented before the American Association for the Advancement of Science a few years since. We cannot forbear to dwell upon the superb illustrations, which make the book a portfolio of art. The author is particularly happy in deciding conflicts of nomenclature, as where he refuses to follow Javary (§ 508) in calling the geodesic on a cone a conical helix.

The author has been extraordinarily painstaking in the proof-reading, and the book is practically free from error. A few trifles have been noticed: Page 156, § 433, first line, for 'prism' read 'cylinder.' Page 171, § 442, first line, for 'axes' read 'bases.' Page 37, sixth line from below, for 90° read 9°. Page 67, § 194, seventh line, for φ read θ.

The slip on page 55, § 166, in stating the brachistochrone and tautochrone properties of the cycloid, is so evidently a reference to a reversed or inverted line inadvertently omitted that it also is trivial. As the briefest hint of contents by chapters: I., definitions. II., free-hand sketching. III., draughtsman's outfit. IV., use of instruments. V., higher plane curves. VI., conventional representations. VII., lettering. The treatment of lettering is particularly full and 64 alphabets are given. VIII., copying processes. IX., Descriptive Geometry of Monge. X., projections, intersections, development of surfaces, with applications to elbow joints, blast pipes, arch constructions, etc. XI., trihedrals. XII., projection of sphere. Here the now disused orthographic projection is somewhat condensed, but the stereographic, which is used, is treated at compensatory length. XIII., shades and shadows. XIV., perspective. XV. and XVI., isometric and clinographic projection, with applications; also crystals in oblique projection. XVII., bridge details, toothed gearing, etc. Out of a host of beautiful figures we may mention 92 as particularly efficient in teaching homology or *complete plane perspective.*

It is a particular pleasure to welcome the book, because it is on just the lines where English and American mathematics has hitherto been sterile.

Even now the tremendous, the fundamental importance of von Standt's geometry of position, the pure projective geometry, both for science and philosophy, is realized by few. For example, in the Bolyai type of non-Euclidean geometry, not only is the straight line infinite, but also it has two distinct points at infinity; it is never closed, even by points at infinity. Writing in 1835, even the superhuman penetration of Lobachévski attributed this essential openness to the straight in itself. In the introduction to his 'New Elements of Geometry,' he says: "I consider it unnecessary to analyze in detail other assumptions too artificial or arbitrary. Only one of them still deserves some attention, namely, the passing over of the circle into a straight line. Moreover, here the fault is visible from the beginning in the violation of continuity, when a curve which does not cease to be closed, however great it may be, must change immediately into the most infinite straight line, since in this way it loses an essential characteristic.

In this regard the imaginary geometry [the non-Euclidean geometry] fills out the interval much better. When in it we increase a circle all whose diameters come together at a point; finally we so attain to a line such that its normals continually approach, although they no longer can cut one another. This characteristic does not pertain to the straight, but to the curve which, in my paper 'On the Foundations of Geometry,' I have called *circle-limit.*"

Of course, it was not until in the next decade (1847) that von Standt published his immortal 'Geometrie der Lage,' but long afterward Helmholtz suffers still more seriously for lack of the pure projective geometry, treating the projective questions which necessarily came up in his extended optical researches, sometimes by means and methods of his own make, sometimes only by general reasonings.

Again, in *Mind* (1876) Helmholtz misses thus a fundamental difference. He says, p. 315: "It is, in fact, possible to imagine conditions for bodies apparently solid such that the measurements in Euclid's space become what they would be in spherical or pseudospherical space. * * * Think of the image of the world in a convex mirror. * * * Now Beltrami's representation of pseudospherical space in a sphere of Euclid's space is quite similar, except that the

background is not a plane as in the convex mirror, but the surface of a sphere, and that the proportion in which the images, as they approach the spherical surface contract, has a different mathematical expression."

But in reality these differences are so fundamental as to make all the difference between Euclidean and non-Euclidean; for the changed measure for distance in the mirror world is still Euclidean, parabolic, using an imaginary conic in the plane background as 'absolute' in Cayley's sense.

Thus Helmholtz reproduced the old but false theorem that in space of positive curvature two geodetic lines, if they in general cut, must necessarily cut in *two* points. He never attained the conception of single elliptic space, the type-form, but speaks only of 'spherical space of three dimensions.'

It is to be hoped that Professor Willson's book may hasten the day in America when courses in descriptive geometry and pure projective geometry, no longer confined to science schools, may be available in every college, and when there may be a more adequate realization of the power of spatial imaging as an instrument in scientific research.

GEORGE BRUCE HALSTED.

AUSTIN, TEXAS.

Chapters on the Natural History of the United States. By R. W. SHUFELDT, M. D., etc. New York, Studer Bros. 1897. Pp. 480.

This volume is a collection of articles, most of which were published originally in 'Shooting and Fishing' and other periodicals, and now reappear, revised and somewhat expanded. A wide range of topics is covered—insects, crustaceans, fishes, amphibians, reptiles, birds and mammals occupy one or more chapters each, by far the larger space being given to birds. As a rule, each chapter treats some general subject, such as 'Crayfish and Crabs,' 'Gulls and their Allies,' 'The American Warblers and Sparrows,' passing the whole group in review, mentioning some of its more striking forms, and giving detailed descriptions of one or two species, with extended accounts of their habits, these latter often augmented by quotations of considerable length from various well-known authors. The anatomy of the animal under consideration is occasionally touched upon and questions of classification are frequently discussed—matters which, it may be feared, will not prove very interesting to the general reader, for whom the work is intended.

The book is illustrated with a hundred and thirty figures, many of them occupying full pages. Nearly one-half are reproductions of photographs of living animals, and are worthy of considerable study for the light they throw upon the possibilities and the difficulties in the use of photography for zoological illustration.

C. F. B.

SOCIETIES AND ACADEMIES.

BIOLOGICAL SOCIETY OF WASHINGTON, 287TH MEETING, SATURDAY, FEBRUARY 26.

DR. E. A. DE SCHWEINITZ presented a paper on 'The Treatment of some Animal Diseases with Antitoxic Serums,' briefly reviewing the work as carried on in the Bureau of Animal Industry some years ago for the purpose of treating animals with the poisons formed by the swine plague and cholera suis germs. This work was fairly successful from an experimental standpoint, but did not seem to warrant practical use in the field on account of many difficulties which might arise. The preliminary experiments made in the Biochemic Laboratory with the serum of animals immune to cholera suis, in 1892, and again with those immune to cholera suis and swine plague germs, published in August, 1896, showed that these two diseases of swine which cause such enormous losses to the farmers of the country could be cured in experimental animals. Accordingly, practical field experiments were tried, which demonstrated that sick herds could be greatly benefited and a large portion of the animals cured if they were given injections of sufficiently strong serum that had been carefully prepared for the purpose of curing the two diseases above mentioned. The expense of this method if legitimately conducted is comparatively small, and it is possible to prepare a serum that would have the desired curative effect which should not cost more than 10 cents for each injected animal. Further practical experiments on a more extensive scale will be conducted, but the